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Notes on Geographic Distribution

An update on the distribution of the Brazilian funnel-eared bat, *Natalus macrourus* (Gervais, 1856) (Mammalia, Chiroptera), with new records from the Brazilian Northeastern

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Abstract: We present data on the geographic distribution, morphology, and biology of the Brazilian funnel-eared bat, *Natalus* (Gervais, 1856), with new records for the Brazilian state of Sergipe, filling a gap of approximately 800 km in the distribution of the species in Brazilian Northeast.

The bat family Natalidae includes three extant genera, *Nyctiellus* Gervais, 1855, *Chilonatalus* Miller, 1898, and *Natalus* Gray, 1838, and the extinct *Primonatalus* Morgan and Czaplewski, 2003, all of which are endemic to the New World (Tejedor, 2011). Eight species are recognized for the genus *Natalus* – *Natalus jamaicensis* Goodwin, 1959; *Natalus major* Miller, 1902; *Natalus primus* Anthony, 1919; *Natalus stramineus* Gray, 1838; *Natalus tumidirostris* Miller, 1900; *Natalus lanatus* Tejedor, 2005; *Natalus mexicanus* Miller, 1902, and *Natalus macrourus* (Gervais, 1856) (Garbino and Tejedor, 2012; Tejedor, 2011; Simmons 2005).

The Brazilian funnel-eared bat, *Natalus macrourus*, has been recorded in all Brazilian biomes (Taddei and Uieda 2001; Gardner 2007), with considerable gaps in the known range of the species. The present study provides the first records of *Natalus macrourus* from the Brazilian state of Sergipe. The specimens were recorded at six sites in this state (Figure 1; Table 1), including five caves – Casa de Pedra (registered by the Brazilian Speleological Society as SE01), Miaba (unregistered), Toca da Raposa (SE 02), Gruta da Raposa (SE 05), and Caverna da Fumaça (SE 09) – and the Serra de Itabaiana National Park (SINP). Most records were obtained with hand nets capture inside caves, with the exception of those in The Serra de Itabaiana National Park (10°40 S, 37°25 W).

Casa de Pedra cave is located in the municipality of Itabaiana (10°50 S, 37°27 W), and has a horizontal extension of approximately 200 m, with temperatures varying from 25°C to 39°C, between the entrance and the innermost areas, respectively. The surrounding landscape is dominated by pastures and fruit orchards, interspersed with the natural shrubby-arboreal vegetation, which is relatively dense along water streams. A single adult male of *N. macrourus* (CMUFS 0080) was captured inside this cave in February, 2006.

Miaba cave, in the municipality of São Domingos (10°43. S; 37°37. W), is located within the ecotone of the Atlantic Forest and Caatinga domains, known locally as the Agreste. This site is close to the Vaza-Barris River. An adult male (CMUFS 0081) and an adult female (CMUFS 0082) were captured inside the cave in June 2008.

Toca da Raposa is located in Simão Dias (10°44' S, 37°4' W) and is approximately 150 m long, with an entrance 80 cm high and 1 m wide, which opens directly into the cave's principal chamber, which has a roof of approximately 10 m in height. The surrounding landscape is made up of subsistence plots and fragments of caatinga scrub. A group of approximately 20 individuals was seen in the cave, although no specimens were collected.

Gruta da Raposa, in the municipality of Laranjeiras (10°48' S, 37°10' W), is around 90 m in extension, with two entrances in a rocky outcrop, one 2 m above the other. A short passage leads into the main chamber, in which the roosting bats (*Natalus macrourus* and *Carollia perspicillata*) were concentrated. The cave entrance is set within a landscape of pastures and subsistence plots, with occasional fragments of Atlantic Forest. A group of approximately 40 *N. macrourus* was observed in the cave, although no specimens were collected.

Caverna da Fumaça is located in the municipality of Lagarto (10°59' S, 37°42' W). Exploration of this cave is requires specialized equipment, which makes it relatively inaccessible in comparison with the other sites, and it has thus not yet been fully explored, although it is known to include a number of inter-connected passages, which are partially flooded in some cases. The surrounding landscape is made up of cattle pasture and fragments of Atlantic Forest. A group of approximately 40 individuals was seen in the cave, although no specimens were

collected.

The Serra de Itabaiana National Park (10°40 S, 37°25 W), which is located within the municipalities of Areia Branca and Itabaiana, covers a total area of 7966 hectares (Carvalho and Vilar 2005). The area is characterized by extensive anthropogenic impacts, and a complex of habitats ranging from shrubby-arboreal vegetation on sandy soils to dense forests along water courses. We are aware of the existence of one cave at this site located in a sheer rock face, which was inaccessible. At this site, two adult female *N. macrourus* specimens (CMUFS 0009; CMUFS 0043) were collected in mist-nets set over the Água Fria stream in February and April, 2011.

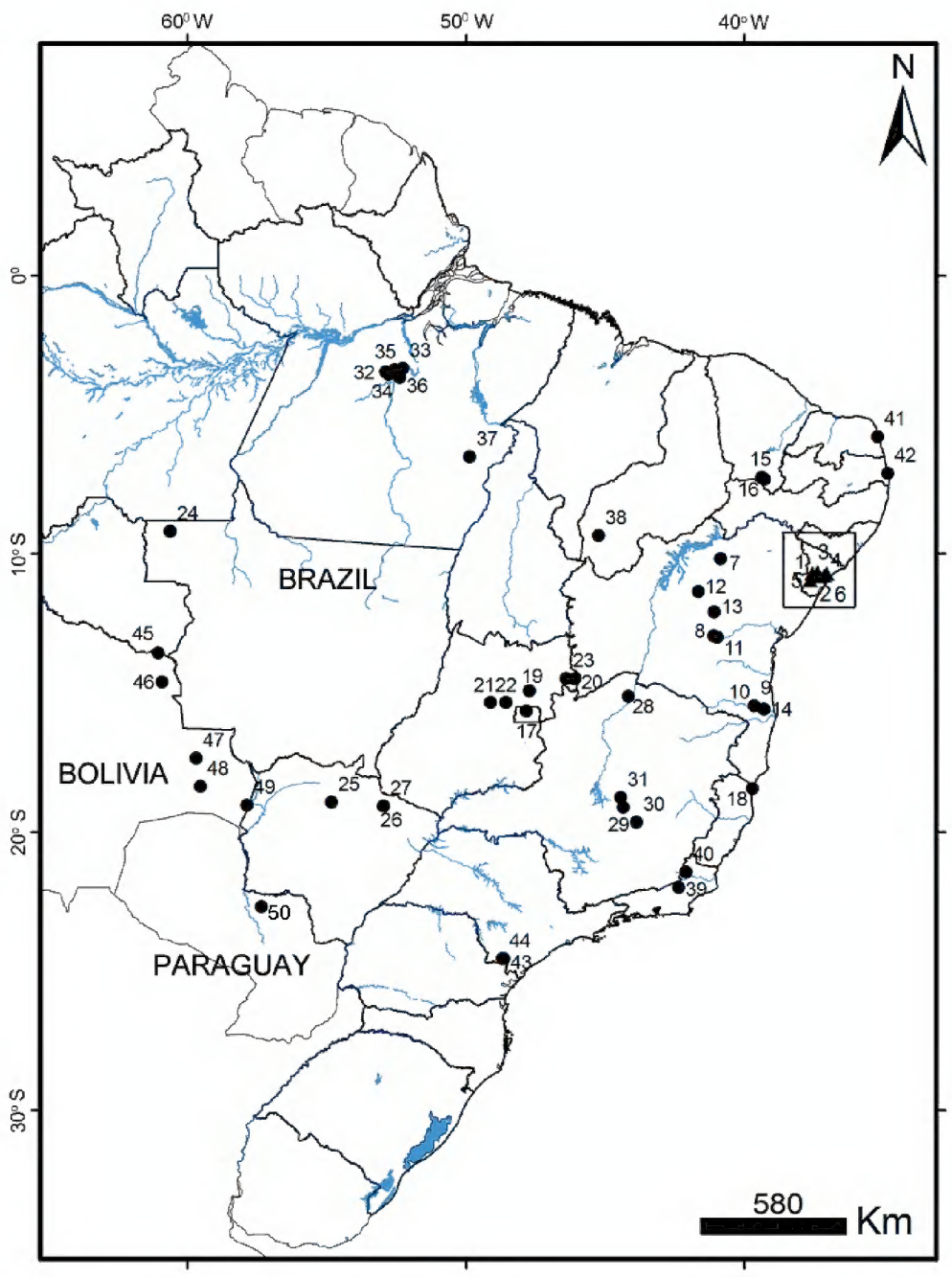
Typically, several *N. macrourus* (normally 20-100 individuals) were observed, but in May and June, 2012, more than one thousand individuals were observed in the Gruta da Raposa, indicating marked seasonal variation in the use of this cave by the species, with the increase in numbers coinciding with the beginning of the rainy season in this region. In the Fumaça cave, pregnant females were observed in January and February, and post-lactant females and juveniles in April. In the Serra de Itabaiana National Park, a lactant female was captured in February. The juveniles present a grayish coloration of the pelage, which is darker on the dorsal surface, quite distinct from the yellowish coloration of the adults (Figure 2).

All the specimens collected were processed according to the recommendations of the Animal Care and Use Committee (1998), fixed in 10% formalin and preserved in 70% alcohol, with the crania being removed subsequently. Following the collection of morphometric data (Table 2), the specimens were deposited in the mammal collection of the Federal University of Sergipe (UFS).

Characters were consistent with Tejedor (2011) to identify *N. macrourus*, including short maxillary toothrow length (6.5-7.0 mm); deeply concave medial margin of auricular pinna; lateral margin of auricular pinna deeply notched; nostrils small and oval, opening ventrolaterally; ventral pelage unicolored; dorsal pelage bicolored, with hair bases lighter; premaxilla not inflated, with premaxillary-maxillary suture anterior to infraorbital foramen; maxilla convex but not inflated; I1 not visible in lateral view, being obscured by I2. The cranial measurements recorded here were within the range of presented by Taddei and Uieda (2001) for *N. macrourus* (Table 2).

The Brazilian funnel-eared bat is closely associated with cave roosts, and over half (29) of the 50 records of the species were derived from surveys of caves (Table 1). A total of 23 caves are known to exist in the Brazilian state of Sergipe, and *N. macrourus* is now known to occur in five, all of which containing an aphotic zone, in which the bats were invariably found.

The present study provides the first records of *N. macrourus* from the Brazilian state of Sergipe filling a gap of approximately 800 km in the distribution of *N. macrourus* between southern Bahia (Tejedor, 2011; Faria *et al*. 2006) and eastern Paraíba (Feijó and Langguth 2011) resulting in a total number of 35 bat species known to occur in the state (Astúa and Guerra 2008; Mikalauskas *et al*. 2011; Rocha *et al*. 2011; Brito and Bocchiglieri 2012).



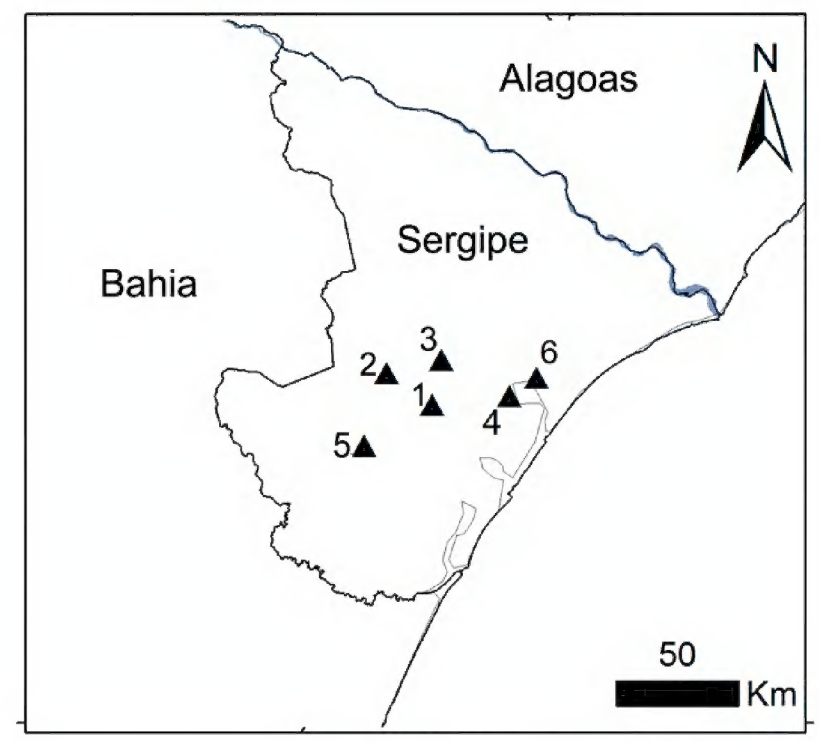


FIGURE 1. Recorded localities for *Natalus macrourus*, modified from Tejedor (2011). For key to code numbers, see Table 2.

Table 1. Localities at which the occurrence of the Brazilian funnel-eared bat *Natalus macrourus* has been confirmed. The code numbers refer to the points shown in Figure 1. Localities marked with an asterisk (*) are caves.

COUNTRY	STATE	LOCALITY	CODE	SOURCE
BRAZIL	Sergipe	Caverna Casa de Pedra, Itabaiana*	1	This study
		Caverna Miaba, São Domingos*	2	This study
		Parque Nacional Serra de Itabaiana, Itabaiana	3	This study
		Gruta da Raposa, Laranjeiras*	4	This study
		Caverna da Fumaça Lagarto*	5	This study
		Toca da Raposa, Simão Dias*	6	This study
	Bahia	Toca da Boa Vista, Laje dos Negros, Campo Formoso*	7	Tejedor (2011)
		Poço Encantado, Itaete	8	Tejedor (2011)
		Gruta Toca dos Morcegos*	9	Tejedor (2011)
		Gruta California, Pau Brasil*	10	Tejedor (2011)
		Caverna Poço Encantado, Chapada Diamantina, Itaetê *	11	Gregorin and Mendes (1999)
		Abrigo da Vespa, Chapada Diamantina, João Dourado*	12	Sbragia and Cardoso (2008)
		Alto do Bonito, Chapada Diamantina, Utinga*	13	Sbragia and Cardoso (2008)
		Pardo River Valley*	14	Faria *et al.* (2006)
	Ceará	9 Km S Crato, Floresta Nacional Do Araripe	15	Willig (1983)
		Barbalha, Serra do Araripe, Arajara	16	Tejedor (2011)
	Distrito Federal	Gruta da Saúva, Sobradinho*	17	Taddei and Uieda (2001)
	Espírito Santo	Gruta do Rio Itaúnas, Itaúnas, Conceição da Barra*	18	Ruschi (1951)
	Goiás	Colinas do Sul	19	Taddei and Uieda (2001)
		Gruta de Porcos, Mambaí*	20	Tejedor (2011)
		Lapa do Fuzil, Goianésia*	21	Taddei and Uieda (2001)
		Padre Bernardo	22	Taddei and Uieda (2001)
		Área de Proteção Ambiental Nascentes do Rio Vermelho*	23	Esberard *et al.* (2005)
	Mato Grosso	Aripuanã	24	Mok *et al.* (1982)
	Mato Grosso do Sul	Rio Verde de Mato Grosso	25	Taddei and Uieda (2001)
		Paranaíba	26	Tejedor (2011)
		Paraíso	27	Taddei and Uieda (2001)
	Minas Gerais	Caverna Olhos D'Agua, Itacarambí*	28	Trajano and Gimenez (1998)
		Furna Misteriosa, Sete Lagoas*	29	Tejedor (2011)
		Lagoa Santa	30	Winge, 1893
		Curvelo	31	Tavares *et al.* (2010)
	Pará	Medicilândia	32	Taddei and Uieda (2001)
		Caverna do Tatajuba, Altamira, 17 km S by Road*	33	Tejedor (2011)
		Caverna do Limoeiro*	34	Trajano and Moreira (1991)
		Caverna Planaltina*	35	Trajano and Moreira (1991)
		Cachoeira Espelho, Rio Xingú	36	Taddei and Uieda (2001)
		Floresta Nacional dos Carajas*	37	Tavares *et al.* (2012)
	Piauí	São João do Piauí	38	Taddei and Uieda (2001)
	Rio de Janeiro	Caverna Santana, Cantagalo*	39	Esberard *et al.* (1998)
		Paraíso do Tobias, Miracema	40	Esberard *et al.* (2010)
	Rio Grande do Norte	Natal	41	Goodwin (1959)
	Paraíba	João Pessoa	42	Feijó and Langguth, 2011
	São Paulo	Caverna Gurutuva, Iporanga*	43	Tejedor (2011)
		Caverna Santana, Iporanga*	44	Tejedor (2011)
BOLIVIA	Santa Cruz	Flor de Oro	45	Tejedor (2011)
		Los Fierros	46	Tejedor (2011)
		Cueva Concesíon Minera Don Mario, San Juán de Chiquitos*	47	Tejedor (2011)
		Cave, Santiago de Chiquitos*	48	Tejedor (2011)
		Cueva Concepcioncita, Motacucito, Puerto Suárez*	49	Tejedor (2011)
PARAGUAY	Concepcíon	Parque Nacional Serranía de San Luis, Concepcíon	50	Tejedor (2011)

Table 1. Cranial measurements of the *Natalus macrourus* specimens collected during the present study, and at other localities in Brazil.

MEASUREMENTS	THIS STUDY		TADDEI AND UIEDA 2001	
	Male (n=2)	Female (n=3)	Male (n=34)	Female (n=26)
Greatest length of skull	15.68 - 16.85	15.96 - 16.29	16.5 – 16.8	16.5 – 17.2
Condylobasal length	14.33 - 14.51	14.65 - 15.9	14.8 – 15.4	15.1 – 15.6
Mastoidal breadth	7.81 - 7.84	7.75 - 7.87	7.2 – 7.8	7.5 – 7.9
Zygomatic breadth	7.81 - 8.95	8.48 - 8.73		
Breadth of braincase	8.11 - 8.13	8.07 - 8.15		
Postorbital constriction	3.69 - 3.7	3.69 - 3.72	3.2 – 3.5	3.2 – 3.4
Palatal length	8.63 - 8.4	8.1 - 8.2		
Palatal breadth	2.71 - 3.09	2.64 - 3.43		
Breadth across upper canines	3.38 - 4.22	3.84 - 4.23		
Breadth across upper molars	5.41 - 5.51	4.93 - 5.77		
Length of maxillary toothrow	6.98 - 7.69	6.93 - 7.33	6.7 – 6.9	6.7 – 7.1
Length of mandible	11.58 - 12.25	12.01 - 12.07	11.6 – 11.9	11.7 – 12.2

Figure 2. (A) juvenile and (B) adult *Natalus macrourus* from Caverna da Fumaça.

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